#### JAMES T. HAYES WRITTEN DIRECT TESTIMONY

I am James T. Hayes, President and Principal Environmental Planner at Planning Solutions, Inc. ("PSI").

I received two A.B. degrees (one as an Earth and Planetary Science major and the other as an International Development major) in 1989 from Washington University in St. Louis. I have worked in the environmental consulting field since the early 1990s with various firms, including PB Americas, Inc. (aka Parsons Brinckerhoff; "PB"), in Honolulu and San Francisco before joining PSI in April 2015. My duties and responsibilities at PSI include supervising a team of professionals primarily engaged in the preparation of environmental documents and permit applications for infrastructure projects in the State of Hawai'i. The projects we typically work on include compliance with a wide variety of local, state, and federal regulations, including HRS Chapter 343 and the National Environmental Policy Act ("NEPA"). A copy of my curriculum vitae was submitted as Exhibit A-35. Exhibit A-36 contains demonstratives I prepared to aid in my testimony.

In July 2008, PB was retained by the TMT Observatory Corporation (the predecessor entity to TMT International Observatory LLC) to prepare an Environmental Impact Statement ("EIS") (Exhibits A-2, A-3, A-4, A-5). I served as PB's project manager in connection with the preparation of the EIS for the Thirty Meter Telescope project ("TMT Project" or "Project"). After completing work on the EIS for the TMT Project I assisted with preparation of the Conservation District Use Application ("CDUA") (Exhibit A-1) and have visited the Mauna Kea summit region periodically, most recently on October 6, 2016.

<sup>&</sup>lt;sup>1</sup> As part of my work preparing the EIS and CDUA, I reviewed, among other things, the documents that were submitted as Exhibits A-1, A-2, A-3, A-4, A-5, A-6, A-48, A-51, A-54, A-70, A-71, A-76 through A-91, A-103 through A-105, A-108 through A-110.

#### **The Environmental Impact Statement Process**

The TMT Project has complied with the EIS process required under Hawai'i Revised Statutes ("HRS"), Chapter 343 (Environmental Impact Statement Law) and Chapter 200 of Title 11, Hawai'i Administrative Rules ("HAR") (Department of Health, Environmental Impact Statement Rules).

First, advertisements were placed in the local newspapers informing the public that an EIS Preparation Notice/Environmental Assessment ("EISPN/EA") was forthcoming. The EISPN/EA prepared pursuant to HRS Chapter 343 was issued for the Project on September 23, 2008. Six scoping meetings were held around the island of Hawai'i and one was held on O'ahu. On May 23, 2009, the Draft EIS for the Project was issued for public and agency review, and seven public meetings were held to receive comments from the public and agencies during the 45-day review period, which ended on July 7, 2009. The Project's Final EIS was prepared to respond to the comments received during the Draft EIS review period, and was issued on May 8, 2010. Exhibits A-3, A-4, A-5. The Governor of Hawai'i accepted the Final EIS as detailed in a letter dated May 19, 2010. Exhibit A-6.

#### **Visual and Aesthetic Resources**

Section 3.5, pages 3-80 through 3-104 of the TMT Final EIS (<u>Exhibit A-3</u>), discusses the visual and aesthetic resources and potential Project impacts to those resources. With respect to cumulative impacts, both the existing level (pages 3-217 and 3-218) and potential future level (pages 3-230 through 3-232) are discussed in Section 3.16 of the Final EIS. In addition the EIS' discussion of the Project's visibility in the summit region (Section 3.5.3, page 3-99 through 3-100), Figure 2 has been developed to summarize the Project's distance and visibility from select known and possible cultural practices areas.

A number of techniques were used to assess the visual resources and potential TMT Project impacts. These included:

- Reviewing community plans that discuss visual resources, including the <u>Hawai'i</u>
   <u>County General Plan</u> (County of Hawai'i, 2005), and the <u>South Kohala Development</u>

   <u>Plan</u> (County of Hawai'i, 2008).
- Reviewing the existing level of cumulative impacts of the existing observatories.
- Determining the "viewshed" of the TMT Observatory.
- Evaluating the "viewplanes" of the areas within the TMT viewshed.
- Performing a silhouette analysis.
- Preparing photo simulations.

The results of these assessments are described below.

These methods were described in the Project's EISPN and further detailed in the Draft EIS along with the results. Input was sought on the methods and results during the review periods for those documents, including at seven public meetings around the state. Certain individuals and groups who are now petitioners in this contested case received those documents and/or attended the meetings. No input was received suggesting other/additional methods be employed to evaluate the visual impact of the Project.

#### Plans

The <u>Hawai'i County General Plan</u> identified the following views that include Mauna Kea:

- View of Mauna Kea and Mauna Loa from Pahoa-Kea'au, Volcano-Kea'au Roads, and various Puna subdivisions;
- Viewpoint of Hilo Bay with Mauna Kea in background; and

#### • Mauna Kea State Park area.

The <u>South Kohala Development Plan</u> recommends the strategy to "protect the pu'u of Waimea that have cultural, historical and visual importance" and which have "grand views of Mauna Kea"

# Existing Level of Cumulative Impacts.

At the time the EIS was prepared, and currently, there were and are 11 observatories on Mauna Kea within the Astronomy Precinct.<sup>2</sup> The 11 observatories and the attributes that affect their visibility are listed in Table 1 below. Some of these existing observatories are visible from locations around the island such as Hilo, Honoka'a, and Waimea; the viewshed of each observatory, i.e., the percent of the island's land area from which the observatory is potentially visible, is listed in Table 1. On the west coast of the island, the existing observatories appear most visible at sunset, when they are lit by the setting sun; on the east coast they appear most visible at sunrise. Considering all existing observatories together, at least one observatory is visible from roughly 43 percent of the island's land area.

**Table 1: Existing Observatory Visual and Aesthetic Attributes** 

Observatory	2000 Master	Ground	Dome	Dome	Viewshed
	Plan Sitting	Elevation	Height (feet)	Color	(%)
	Area	(feet)			
Subaru	В	13,578	141	Metallic	20
Keck	В	13,603	111	White	17
IRTF	В	13,652	53	Aluminum	14
CFHT	Α	13,726	125	White	35
Gemini	Α	13,764	151	Aluminum	39
UH 2.2m	Α	13,784	80	White	36
UKIRT	Α	13,762	61	White	26
UH Hilo 0.9m	A	13,727	20.25	White	15
CSO	С	13,362	63	Metallic	5
JCMT	С	13,390	100	White	7

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<sup>&</sup>lt;sup>2</sup> The Astronomy Precinct is comprised of 525 acres of land located within the Mauna Kea Science Reserve ("**MKSR**"). The entire 10,288 acre MKSR is designated as a Resource subzone. Although astronomy is an expressly permitted use within the MKSR Resource subzone, the University of Hawai'i has confined astronomy facilities to the Astronomy Precinct.

Observatory	2000 Master	Ground	Dome	Dome	Viewshed
	Plan Sitting	Elevation	Height (feet)	Color	(%)
	Area	(feet)			. ,
SMA	С	13,279 - 13,400	45	NA	2

The existing development on Mauna Kea does not block or obstruct any of the identified views in the County of Hawai'i General Plan or the South Kohala Development Plan. The existing observatories are, however, visible within the viewplanes from Hilo, Waimea, and the summit. Overall, the existing level of the cumulative visual impact from past projects at the summit is considered to be substantial, significant, and adverse. This assessment of the existing level of cumulative visual impact is consistent with the Final Environmental Impact Statement for the Outrigger Telescopes Project, which, in Section 4.2.14.4, page 4-119, states: "The visual impacts of past and present astronomy-related activities in the MKSR have been substantial."

# **TMT Observatory Viewshed**

A geographic information system-based viewshed analysis was conducted based on topography to assess which areas of the island may have a view of the TMT Observatory. According to the viewshed analysis, the TMT Observatory will be visible from roughly 14 percent of the island area, as depicted in Figure 1 from nearly all this area, existing observatories are currently visible. According to the 2000 U.S. Census data, approximately 15.4 percent of Hawai'i's\_population, or 23,000 people, live within the viewshed of the TMT Observatory.

Others, including visitors and island residents who reside outside the viewshed, will be able to see the TMT Observatory when they travel through and visit locations within the viewshed. The results of this analysis are shown in Figure 1. As shown in Figure 1, the shaded portions of the island are areas where at least the top of the TMT Observatory may be visible.

Legend Proposed 13N Site Observatory Visible Visible from Viewpoint Not Visible from Viewpoint Direction of Primary View Panoramic View 14% of Island has Visibility

Figure 1: Viewshed and Primary View Analysis

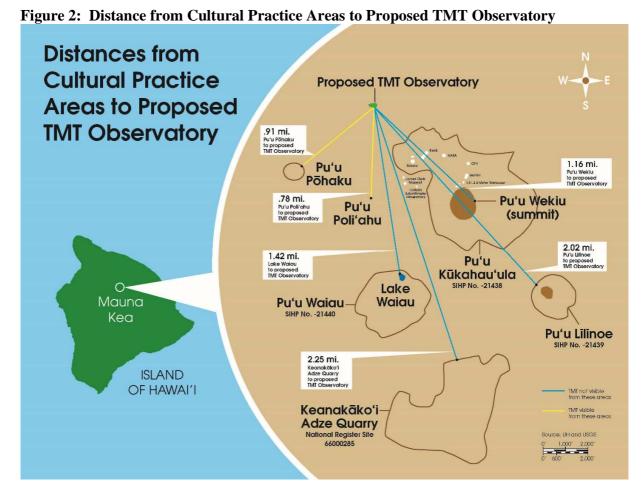
#### Viewplanes

Representative viewpoints within the northern portion of the island were identified as places that are of visual significance. *See* Exhibits A-54, A-109, A-110. The viewpoints and the direction of the primary view from each viewpoint are mapped in Figure 1 and Error!

Reference source not found. summarizes which of the viewpoints the TMT Observatory would be at least partially visible. The primary view is the direction of view that is the primary attraction at the viewpoint. Typically, near the ocean the ocean is the primary view, and away from the ocean the mountains are the primary view.

Based on this assessment, the TMT Observatory will be visible in the primary view direction only from the area around Waimea. Of the island's population, 5.5 percent, or 8,100 people, reside within the area around Waimea and may be able to see the TMT Observatory.

No portion of the TMT Observatory will be visible from the Mauna Kea summit or Lake Waiau (viewpoint 17, Figure 1). In addition, as illustrated in Figure 2, the observatory will not be visible from Pu'u Līlīnoe or the Keanakāko'i Adze Quarry. It will, however, be visible from locations in the northern portion of the summit region, including Pu'u Poli'ahu, from which it will be partially visible, and Pu'u Pohaku as summarized on Figure 2.



The TMT Observatory will not interfere with views of the sunrise, sunset, the shadow of Mauna Kea, or the Southern Cross constellation from any of the identified viewpoints.

Furthermore, the TMT Observatory will not interfere with view of these events or resources unless the observer is located in close proximity to the observatory structure.

# Silhouette Analysis

For the 13 viewpoints where the TMT Observatory may be visible, a silhouette analysis was conducted to determine whether the view of the Observatory will be a full or partial silhouette against the sky, or whether it will be seen against the backdrop of Mauna Kea. Table 2 summarizes the silhouette analysis for the TMT Observatory and the potential long-term impact to visual and aesthetic resources.

**Table 2: Summary of TMT Observatory Silhouette Analysis** 

Viewpoint	Location	Visible in silhouette?			
	Location	No	Partial	Full	
1	Hualālai Resort		164 feet (50 m)		
2	Puʻu Waawaa		58 feet (17 m)		
3	Big Island Country Club		82 feet (25 m)		
4	Waikoloa/Mauna Lani		164 feet (50 m)		
5	Hāpuna Beach	N/A, TMT Observatory not visible			
6	Puukohola Heiau		164 feet (50 m)		
7	DHHL Kawaihae at Route 250	Х			
8	Route 250 Pu'u Overlook	Х			
9	DHHL Lalamilo		49 feet (15 m)		
10	Waimea Park		89 feet (27 m)		
11	DHHL Pu'u Kapu		98 feet (30 m)		
12	DHHL Waikoloa-Waialeale		164 feet (50 m)		
13	Waipio Valley Lookout	N/A, TMT Observatory not visible			
14	Honoka'a		82 feet (25 m)		
15	Laupāhoehoe Point	N/A, TMT Observatory not visible			
16	Mauna Kea Summit	N/A, TMT Observatory not visible			
17	Lake Waiau	N/A, TMT Observatory not visible			
18	North ridge of Kūkahau'ula	X			

### Photo Simulations.

In compliance with Comprehensive Management Plan ("CMP") (Exhibit A-9)

Management Action FLU- 4, visual renderings of the Project setting were prepared.

Views from Lower Elevation Developed Areas

When assessing the views from the lower elevation developed areas, photo simulations of the TMT Observatory were created using photographs of the summit of Mauna Kea that were taken with a 600 mm/5.6 telephoto lens resulting in a "binocular view" - *i.e.*, a magnified view, simulating what the TMT Observatory would look like if seen through binoculars. This binocular view was done because in typical 50 mm lens photographs simulating a "naked eye view," the TMT Observatory was barely visible due to the distance between the location where the photograph was taken (where the bulk of potential viewers reside) and the location of the TMT Observatory. An example of the naked eye view (i.e., a 50 mm lens photograph) of Mauna Kea from Waimea is shown in Figure 3.



Figure 3: Naked Eye View of Mauna Kea from Waimea

Figure 4 through Figure 9 illustrate the TMT Observatory with various finish colors in binocular (i.e., magnified) views from the Waimea area, with and without snow on the ground.

Figure 4: Simulation of TMT Observatory, Aluminum-Like Finish – "Binocular" View from Waimea with no Snow



Photo Credit: CFHT

Figure 5: Simulation of TMT Observatory, White Finish – "Binocular" View from Waimea with no Snow  $\,$ 



Photo Credit: CFHT

Figure 6: Simulation of TMT Observatory, Brown Finish – "Binocular" View from Waimea with no Snow



Photo Credit: CFHT

 $\begin{tabular}{ll} Figure 7: Simulation of TMT Observatory, Aluminum-Like Finish-"Binocular" View from Waimea with Snow \\ \end{tabular}$ 



Photo Credit: Charles R. West Photography

Figure 8: Simulation of TMT Observatory, White Finish – "Binocular" View from Waimea with Snow



Photo Credit: Charles R. West Photography

Figure 9: Simulation of TMT Observatory, Brown Finish – "Binocular" View from Waimea with Snow



Photo Credit: Charles R. West Photography

These simulations from Waimea illustrate that the TMT Observatory will be below the summit of Mauna Kea and the existing observatories. From the view presented, the lower

portion of the TMT Observatory will be obscured behind a rise of Mauna Kea and located in front of one of the domes of the existing Keck or Subaru Observatory. Roughly the top 90 feet of the observatory dome will be visible from the Waimea area, as listed for viewpoints 9, 10, and 11 in Table 2. These simulations show that the reflective aluminum-like finish appears less obtrusive than the white finish when there is no snow.

Similar simulations were also prepared for views from Honoka'a and Waikoloa village.

These are shown in Figure 10 and Figure 11, respectively, and are also binocular (i.e., magnified) views.

Figure 10: Simulation of the TMT Observatory, Aluminum-Like Finish – "Binocular" View near Honoka'a



Figure 11: Simulation of the TMT Observatory, Aluminum-Like Finish – "Binocular" View from Waikoloa



Photo Credit: Charles R. West Photography

# Views within the Summit Region

The TMT Observatory will not be visible from the summit of Mauna Kea, viewpoint 16, or Lake Waiau, viewpoint 17. It will be visible from other locations within the summit region, primarily the northern plateau and the northern ridge of Kūkahau'ula where the Subaru, Keck, IRTF, and CFHT observatories are located, viewpoint 18 (Figure 1) and other locations on the north side of Maunakea (Figure 2). Figure 12 shows the current view from near the Keck Observatory, viewpoint 18, looking to the northwest, looking over the northern plateau and the TMT Observatory 13N site. Figure 13 is a simulation of the TMT Observatory with an aluminum-like finish from the same viewpoint.





Figure 13: Simulation of the TMT Observatory with an Aluminum-Like Finish from Near Keck Observatory Viewing Northwest



As the simulation in Figure 13 shows, from this perspective, the TMT Observatory will add a substantial new visual element in the landscape that will be visible from viewpoints along

the northern ridge of Kūkahauʻula and by people as they travel within the northern portion of the summit region, including Puʻu Poliʻahu. Currently, views from the northern ridge of Kūkahauʻula are already dominated by views of observatories, including Subaru, Keck, IRTF, and CFHT observatories, which are located on the northern ridge; all the existing observatories are also visible from the top of Puʻu Poliʻahu. In addition, TMT's lower elevation and its size and height mean it will not block the view of Maui from the ridge or Puʻu Poliʻahu (Figure 14 and Figure 15).

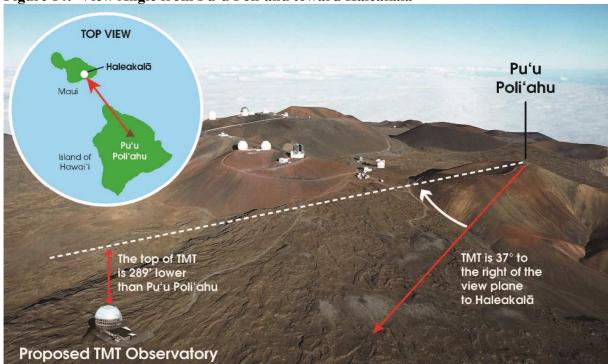


Figure 14: View Angle from Pu'u Poli'ahu toward Haleakalā

Figure 15: Simulation of the TMT Observatory, Aluminum-Like Finish from Pu'u Poli'ahu



The majority of visitors to the summit region and cultural practitioners visit the eastern ridge of Kūkahauʻula and the Kūkahauʻula summit, not the northern ridge of Kūkahauʻula. This is presumably because (a) the area near the UH 2.2m observatory on the eastern ridge is the highest vehicle-accessible point, roughly 135 higher than the northern ridge; (b) parking is available near the UH 2.2m observatory; (c) the UH 2.2m observatory is near the Kūkahauʻula summit trailhead; and (d) the Kūkahauʻula summit is the highest place in Hawaiʻi and the Pacific. Since 2013, OMKM has discouraged visitors from hiking to the Kūkahauʻula summit. Nevertheless, visitors continue to ascend the summit as well as cultural practitioners. Therefore, the eastern ridge and summit remain the most visited areas of the summit region. The TMT Observatory will not be visible from the UH 2.2m Observatory or the Kūkahauʻula summit. Mitigation Measures.

The primary mitigation measures to address the visibility of the TMT Observatory are:

• Location. The location of the TMT Observatory significantly reduces the Project's potential visual impacts. Because the location proposed for the TMT Observatory is north of and below the summit of Mauna Kea, it will be substantially less visible than

if it were to be placed in a more visible location, such as on the summit ridge or on a pu'u.

**Design**. The telescope itself has been designed to be as short as possible for one with a 30-meter primary mirror by using a focal ratio<sup>3</sup> of f/1.0, which allows for the smallest dome feasible. The primary mirror is closer to the surrounding ground surface than other observatories on Mauna Kea. In addition, the enclosure has been designed to fit very tightly around the telescope, leaving just enough room for a person, only about 20 inches, between the telescope and the dome (Figure 16). This results in a dome with a diameter of 216 feet and total height of approximately 180 feet. If the TMT Observatory were to use a more traditional mirror-to-dome size, such as that of the Keck Observatory, it would result in a dome with a diameter of 364 feet, almost twice that of the current design (Figure 17).

Secondary Mirror Tight fit (20°) to reduce size of dome Focal Ratio (f) I.0 to reduce size of dome Primary Mirror Dome foundation Telescope foundation

Figure 16: Overview of TMT and Dome Design

<sup>&</sup>lt;sup>3</sup> Focal ratio (f/) is defined as the ratio of the focal length of the mirror to its diameter.

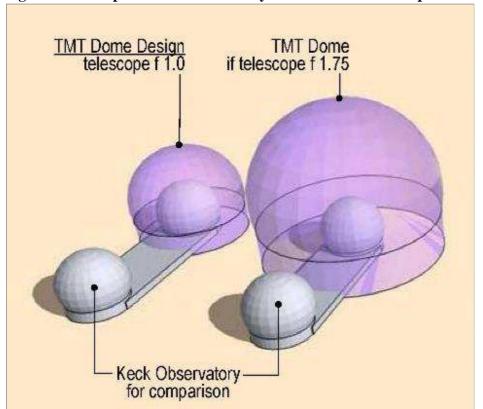


Figure 17: Comparison of Observatory Dome Sizes to Telescope Focal Ratios

- Color. The color, or coating, of the dome enclosure has substantial visual implications. The coating of the dome enclosure will be an aluminum-like coating, similar to that used on the Subaru Observatory. In general, an aluminum-like coating reflects the morning sunrise and evening sunset light and stands out during those periods; however, during most of the day, the coating reflects the sky and reduces the visibility of the observatory.
- **Support Building**. The support building is relatively small and low relative to the size of the dome and telescope, and would only be visible from viewpoints relatively close to the Project site. Its design further incorporates features to reduce its visibility from the Kūkahau'ula historic property. The building will be lava-colored to blend

with its surroundings, and the employee parking areas will not be visible from Kūkahau'ula.

# Visual Impact of the TMT Observatory in Context of Existing Conditions

The standard industry practice for conduct a visual impact analysis is to consider the context of the proposed land use. In other words, the impact of the proposed Project must be assessed in the context of the Mauna Kea Astronomy Precinct. The Astronomy Precinct is not a bare mountaintop with no telescope structures. Rather, there are 11 other observatories in the Astronomy Precinct. The TMT Observatory will not substantially obstruct or block existing views of Maunakea from around the island of Hawai'i. The TMT Observatory will be visible from only about 14 percent of the island area. The new area where the TMT Observatory will be visible and where currently none of the existing observatories can be seen is approximately only 1.2 percent of the area of the island. Furthermore, the TMT Observatory will be visible to only about 15.4 percent of the population, and the great majority of those residents already can see one or more observatories from their residences. Therefore, while the TMT Observatory will be a new visual element among the existing observatories, it does not substantially alter the current overall visual impact of the Astronomy Precinct area.

In addition to residents within the TMT viewshed, the TMT Observatory will be visible to other island residents and visitors when they travel within the TMT viewshed (Figure 1), including travel along roads and stops at viewpoints. The Project's visual impact is perceived by some to be significant; however, in the context of the existing observatories and the fact that the TMT Observatory will not block or substantially obstruct the identified views and viewplanes of the mountain, which is the applicable significance criteria in § 11-200-12 of the HAR, the Project's visual impact will be less than significant.

Furthermore, the TMT Project incorporates mitigation measures to minimize the visual impact of the Project to the extent practicable to meet the project's scientific objectives. Due to its design and location, the TMT Observatory will be at a lower elevation than other observatories in the MKSR, minimizing its viewshed. The Project has numerous design elements—*e.g.*, the dome's tight fit around the telescope, aluminum-like finish, and color of the road pavement—to further minimize its visual impact.

## Cumulative Visual Impact of Development in the Mauna Kea Summit Region

Although the existing observatories within the MKSR also do not block or substantially obstruct the identified views and viewplanes of the mountain, the Final EIS for the Outrigger Telescopes Project assessed that the current level of cumulative impact – i.e., without the TMT Project – as being "substantial." This NEPA assessment is based on at least some of the observatories being visible from most locations within the MKSR and from many off-mountain locations including Hilo, Waimea, and Honokaa. The EIS prepared for the TMT Observatory adopted the Outrigger Project's NEPA assessment concluding that the existing visual impact is "substantial, significant, and adverse."

The five observatories built prior to 1980 (UH Hokukea, UH 2.2m, IRTF, CFHT, and UKIRT) that remain present are located on the summit ridges. Each of those observatories contributed an incremental visual impact to the cumulative visual impact of the ones that came before it (if any). The accumulation of those five increments resulted in at least one observatory being visible across roughly 43 percent of the island, including within the MKSR, Hilo, Waimea, and Honoka'a, and may have been considered a substantial cumulative visual impact. Since that time additional observatories have been built (i.e., Keck, Subaru, Gemini), each adding an additional increment to the cumulative impact, which may have already been considered

substantial. The incremental increase in cumulative visual impact due to the TMT Project will be minimized to the extent practicable as outlined above, will be less than significant, and includes:

- The addition of the TMT Observatory into the view of Mauna Kea that currently includes one or more (typically 6 or 7) existing observatories from 12.8 percent of the island area, including the northern summit area, Waimea, and Honoka'a.
- The expansion of the land area from which at least one observatory can be seen from 43 percent to 44.2 percent of the island, a 1.2 percent increase within which only a portion of the TMT Observatory will be visible.

When the Project is combined with the existing conditions in the MKSR, the cumulative visual impact of development on and near the summit of Mauna Kea will continue to be significant. However, because the current level of cumulative impact - *i.e.*, without the Project – has already been assessed to be significant, the cumulative visual impact of the Astronomy Precinct will be substantially the same even if the TMT Observatory is not built. Hazardous and Solid Waste

As detailed in Section 3.8.3 of the Final EIS, like the other existing observatories, normal operations and maintenance of the TMT Observatory will utilize vehicle and generator fuel, alcohols used for optics and general cleaning, liquid adhesives for optics bonding, various metals used for coating deposition materials, lubricants, hydraulic fluid, glycol coolants, and small quantities of acids, paints, and solvents. No mercury will be used by the TMT Observatory. The Observatory will utilize a secondary containment area, which will be inspected daily for leaks, to store all hazardous materials or wastes. Fuel storage and piping will also be double-walled and

be equipped with leak monitors. Therefore, the chance of a spill entering the surrounding environment is negligible.

As described in Section 3.8.3 of the Final EIS, like many of the other observatories, mirror washing will be the primary maintenance activity associated with the TMT Observatory. It should be clearly noted that the mirror washing wastewater will not be a hazardous waste. However, the TMT Observatory has been designed to ensure that the possibility of mirror wash wastewater entering the surrounding environment will be negligible. The TMT Observatory design includes a separate mirror laboratory for mirror washing. The laboratory is designed to collect waste from the mirror washing and coating area floor drain and laboratory sinks into double contained piping. The piping will drain by gravity to a holding tank. The tank will either be double walled or will be placed in a concrete basin. The tank will be sized to accommodate at least one week's worth of normal use. Each point of exit from the mirror stripping area will have a trench drain that will drain to the storage tank. All exposed concrete in areas of chemical use will have a chemical resistant coating applied.

A leak detection system will be installed and will monitor the double contained pipes and tank. A level control system will monitor the tank and be equipped with an overfill alarm in the event that the level in the tank reaches 90 percent capacity. The waste collected from the mirror washing process will be removed and transported off site for treatment and disposal. It is estimated that such removal will occur approximately once a month, and the likelihood of an accident is slight. To minimize the potential for an accidental spill while wastes are in transit down the mountain to the proper disposal site, no tank or containers being transported will be filled to the top. To further ensure the safe transport and disposal of hazardous waste, the TMT

Observatory will utilize only EPA-permitted and licensed contractors to transport hazardous wastes.

Also, in compliance with existing regulations and requirements, a Spill Prevention and Response Plan ("SPRP") will be developed and implemented. This plan is described in detail in Section 3.8.3, pages 3-128 through 3-130, of the Final EIS. Exhibit A-3. Both the SPRP and the engineering measures (such as double-walled pipes) will protect against the release of chemicals or fuel to the environment. The SPRP will require inspections to ensure that systems are working properly, no leaks are occurring, and any necessary maintenance measures are taken. The SPRP will also spell out protocols for proper handling, storage, use, and disposal of liquid and solid materials and wastes.

As a result of the Project's design plus implementation of the plans and programs and built-in safeguards detailed in the Final EIS, all designed to comply with applicable rules and requirements, the TMT Observatory's impact related to hazardous materials and hazardous waste will be negligible. The possibility of an accidental release to the environment of any hazardous materials or waste is extremely remote.

As detailed in the Final EIS, with regard to Solid Waste, the Project will (a) collect all solid waste in secured and covered storage containers and truck it down the mountain for proper disposal at an off-site disposal facility; (b) implement a Materials Storage/Waste Management Plan, a component of which will be the SPRP; and (c) implement a Waste Minimization Plan that will include an annual audit to identify waste produced by the Project and how that waste could be reduced, reused, or recycled; among other mitigation measures. Implementation of waste minimization practices during design has eliminated the use of mercury Project-wide.

These measures would be implemented during both construction and operational phases of the Project.

During the construction phase of the Project there is a greater potential for impacts from solid waste and materials. Several components of the Waste Management Plan will address the construction phase specifically, including the following requirements:

- All large shipments will be repacked at the Port Staging Area so that only essential
  packing material is used for final transportation to the construction site. This will
  reduce the volume of waste generated at the construction site.
- Outdoor trash receptacles will be secured to the ground and have attached lids that are secured to the receptacles and plastic liners so that the receptacle, its lid, and its contents will not blow away and the contents will not be exposed to storm water.
- Hazardous materials, fuel, and wastes will be stored in designated areas in containers
  suitable and appropriate for storing such materials according to applicable rules and
  regulations. Storage areas will be located away from storm water and other water
  resources.
- Construction materials and supplies will be covered with heavy tarps; steel cables
  attached to anchors that are driven into the ground may also be used to hold materials
  down. Materials will be secured at the close of each work day, and throughout the
  day during periods of high wind.

Mandatory compliance with existing regulations and requirements will ensure that the Project will not result in a significant impact to the environment due to its solid and hazardous waste management. The implementation of the identified mitigation measures, such as the Waste Minimization Plan, will further reduce the Project's potential impacts.

### **Noise**

Section 3.13, pages 3-173 through 3-181 of the Final EIS, discusses Mauna Kea's sonic environment and potential Project impacts. (Exhibit A-3). The cumulative impacts to the sonic environment, both the existing level (page 3-223) and potential future level (page 3-237), are discussed in Section 3.16 of the Final EIS, and will be less than significant.

The noise generated by the TMT Observatory during a typical day will be the result of the heating, ventilation, and air conditioning ("HVAC") equipment. This equipment will be located inside the observatory facility. The HVAC units are designed to cool the dome in the daytime. Exhaust will be discharged to the northwest, away from the visitor area and the summit. Other noise-producing equipment includes an emergency standby generator that will be used only when power is not available from HELCO and briefly during periodic testing.

At night, the HVAC equipment will continue to operate to keep scientific instruments at their required operating temperatures. The motors used to rotate and open the dome will be the only source of additional noise at night, unlike during the day, which experiences visitor traffic and various other sources of additional noise. Those motors will be located inside the observatory building and enclosed by the structure's walls. The walls will provide for a substantial reduction in sound transmission, so the motors are not expected to be audible from outside the building.

Applying the noise standards contained in HAR § 11-46, the noise generated by the TMT Observatory will be below the daytime Class A allowable limits (55 dBA) at a distance of 270 feet from the HVAC system and below the nighttime Class A allowable limits (45 dBA) at a distance of 850 feet from the system. Therefore, anyone standing at least 270 feet from the TMT Observatory HVAC system during the day will not be exposed to noise levels exceeding the

Class A daytime standard. Areas beyond 850 feet from the TMT Observatory HVAC exhaust output will not experience noise levels exceeding the Class A nighttime standard. All identified noise-sensitive areas in the summit region, including the trailhead and summit of Pu'u Wēkiu/Kūkahau'ula, Lake Waiau, and Pu'u Līlīnoe, are more than 850 feet from the TMT Observatory HVAC system. Operation of the TMT Project will also not contribute to a noticeable increase in noise levels at the identified recreational sites in the surrounding area recognized as sensitive to noise.

Overall, the Project will not detrimentally affect the ambient noise levels or result in a substantial degradation of environmental quality in noise-sensitive areas, and therefore it will result in a less than significant impact. Nevertheless, the Project will implement mitigation measures, including:

- HVAC equipment will be placed indoors. By placing the equipment indoors, the
  noise associated with HVAC equipment motors, evaporators, and condensers will be
  significantly reduced. Therefore, the radius of the area exposed to noise levels
  greater than the Class A standard will also be reduced.
- Openings between the interior of the observatory and outdoors, such as air intake
  locations, will be furnished with measures to reduce noise discharging outside of the
  observatory, such as acoustical louvers.

The implementation of the mitigation measures identified will serve to further reduce the noise associated with the Project.

### Public Access, Trails, and Recreational Activities

The Project will not have any direct effects on public access, and instead, will likely improve public access to the Northern Plateau. As shown in Figure 18 below, there are no trails

in the vicinity of the proposed TMT Observatory site. The nearest known customary trail (Mauna Kea - 'Umikoa Trail) is approximately a mile to the south-southeast. Even the limited amount of road construction that is required for the TMT Project would be more than four-tenths of a mile from the Mauna Kea - 'Umikoa Trail. The distance, and the fact that existing topography blocks views from the trail toward the proposed new facilities, means there is no potential for Project-related work at those locations to adversely affect public access.

The only period and location where Project-related activities within the Conservation

District (other than the use of existing roads) would come close to existing trails is during

construction where the modem trail around the western side of Pu'u Haukea intersects the Mauna

Kea Access Road. That point is a short distance south of the Batch Plant site that would be used

during construction of the Project. While the Batch Plant site is utilized for the TMT Project

construction, it will be visible to trail users, just as it has been during the construction of some

existing Mauna Kea telescopes. This would not deny anyone access to the trail and so is not a

direct effect, although it does have the potential to alter trail users' experience slightly for the

period the Batch Plant site is in use by the TMT Project contractor. No known recreational

activities, including snow play, occur in the vicinity of the TMT Project site. Therefore, with the

exception of the indirect effect on trail users discussed above, the TMT Project will have little to

no effect on recreational activities.

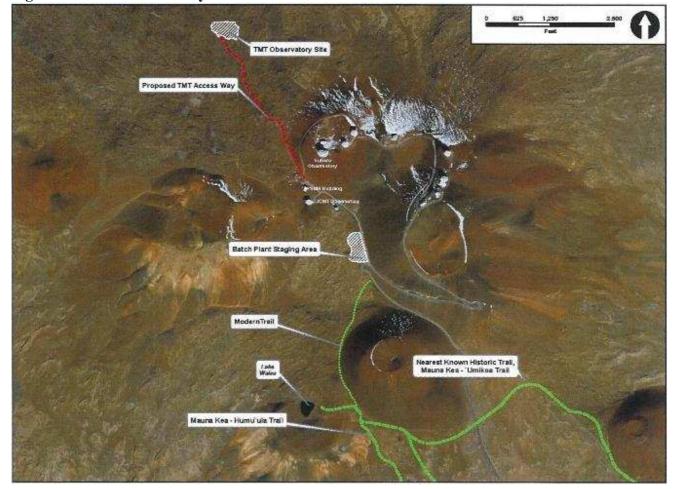


Figure 18: TMT Access Way and Nearest Trails

Any minor, temporary effect on trail users' experience will be more than offset by the long-term indirect benefits from the public education and cultural awareness efforts that the University of Hawai'i Office of Mauna Kea Management intends to undertake. As part of the CMP, a Public Access Plan (PAP) for the UH Management Areas on Mauna Kea was prepared that addresses overall access to the summit area. With existing programs and the implementation of the concepts presented in the CMP and PAP, including the ranger program (which promotes health and safety on Mauna Kea, protects the mountain's cultural, natural, and scientific resources, and provides interpretive services to visitors) and increased education

<sup>&</sup>lt;sup>4</sup> A Final Environmental Assessment for the CMP was filed on April 23, 2009. Exhibit A-51.

programs, the impact to cultural and recreational resources by visitors and employees should be reduced relative to current conditions. Furthermore, the TMT Project calls for the partial re-naturalization of the Batch Plant site following completion of construction, which in the long term should improve conditions in the vicinity of the modern trail.

# **Natural Resources**

The CMP (including its sub-plan, the Natural Resource Management Plan) and studies conducted during preparation of the EIS for the TMT Project provide detailed descriptions of the natural resources, for both the floral and faunal biotic elements, in the alpine stone desert ecosystem above 12,800 feet on Mauna Kea, where Area E, the TMT Access Way, and the Batch Plant are located. *See* Exhibits A-9, A-10, A-11. The plant community in this ecosystem consists of several species of mosses and lichens.

The only resident faunal species in the Alpine Stone Desert ecosystem above 12,800 feet are arthropods. At least 10 confirmed resident species of indigenous Hawaiian arthropod species have been collected near the summit, including: wekiu bugs (*Nysius wekiuicola*), lycosid wolf spiders (*Lycosa* sp.), two sheetweb spiders (genus *Erigone*), two mites (Family *Aystidae* and Family *Eupodidae*: both species unknown), two springtails (Family *Entomobryidae*: two species unknown), a centipede (*Lithobius* sp.), and a noctuid moth (*Agrotis* sp.). Several other indigenous Hawaiian species have also been collected near the summit, but their resident status is unconfirmed. Additional arthropod species, non-indigenous to Hawai'i, are thought to be resident to the summit area cinder cones. One of the indigenous arthropods, the wekiu bug (which was observed along the TMT Access Way near the summit cones), was previously proposed as a candidate species for Federal listing under the Endangered Species Act. The USFWS chose not to list it, indicating they did not feel the species was in danger of extinction

currently or likely to be in danger of extinction in the future throughout all or a significant portion of its range. Wekiu bugs live only in loose cinder habitats on the cinder cones above 11,715 feet on Mauna Kea. They are generally concentrated on the cinder cones in the summit area, but also utilize other habitats.

Studies performed to support the TMT EIS and other University studies on Mauna Kea have not identified species unique to the Project area. This is why, on page 3-72 of the Final EIS, it is stated: "Overall, the displacements will not have a significant impact on biological resources because species and habitat of these areas are not unique to the Project sites and are found elsewhere on Mauna Kea and/or on other islands in Hawai'i." Overall, the displacement of roughly 6 acres of the alpine stone desert lava flow habitat is less than significant because that area represents less than 0.5 percent of that habitat available within the summit region.

This includes the Douglas' bladder fern, which is present in the Astronomy Precinct but also occurs throughout the Mauna Kea Science Reserve, on Maui, and on the eastern slopes of Mauna Loa. The Project did coordinate with the United States Fish and Wildlife Service regarding the fern and other resources but received no specific feedback regarding Project impacts or objections to the Project, but suggested several measures to minimize potential impacts. The Project has implemented the suggestions of the USFWS.

Below is a brief list of measures the TMT Project has proposed to mitigate any potential adverse impacts on natural resources. A more comprehensive description of these measures can be found in Section 3.4 of the TMT Final EIS.

 Arthropods will be monitored in the area of the Access Way prior to, during, and for two years after construction of the TMT Access Way.

- Management Action NR-6: In accordance with CMP management action NR-6, the TMT Project will develop and implement a Cultural and Natural Resources Training Program. This program, detailed in Section 3.4.3 of the TMT Final EIS, will require that TMT personnel receive an annual orientation regarding natural resources.
- Management Action NR-2: In accordance with CMP management action NR-2, the TMT Project will develop and implement an Invasive Species Prevention and Control Program prior to the start of construction. This program, detailed in Section 3.4.3 of the TMT Final EIS, will outline steps to be taken to avoid the potential impacts associated with invasive species.
- Management Action FLU-6: In accordance with CMP management action FLU-6, the TMT Project will develop and incorporate a habitat mitigation plan into its planning process for construction activities. The TMT Access Way has been designed to limit disturbance and displacement of sensitive habitat; the existing roadway will be paved where adjacent to sensitive habitats to reduce dust-related impacts and construction-phase mitigation measures will be implemented to reduce potential impacts to sensitive habitat.
- Ride Sharing: The TMT Project will implement a Ride-Sharing Program that will
  limit vehicle trips to the summit to about 9 per day, including pickup and deliveries.

  Dust generated along unpaved section of the Mauna Kea Access Road and the TMT
  Access Way will be reduced relative to the number of trips reduced by the program.

### **Cumulative Impacts**

Section 3.16, pages 3-207 through 3-253 of the Final EIS, discusses cumulative impacts in detail, including the existing level of cumulative impacts and the potential future level.

As summarized in Section 3.16.6, page 3-243 of the Final EIS, the cumulative impacts to certain resources of past and existing development in the Astronomy Precinct have already been substantial, significant, and adverse; the addition of the Project will result in only limited, incremental impacts, and will not result in any new significant or adverse impacts: "From a cumulative perspective, the impact of past, present, and the Project together with other reasonable foreseeable future actions on cultural, archaeological, and historic resources is substantial, significant, and adverse. The cumulative impact to geologic resources in the astronomy precinct has been substantial, significant, and adverse. The cumulative impact to the alpine shrublands and grasslands and mamane subalpine woodlands has also been substantial, significant, and adverse, primarily due to grazing by hoofed animals. The magnitude or significance of cumulative impact to the alpine stone desert ecosystem is not yet fully determined.

"The cumulative socioeconomic impact is substantial and beneficial."

"In general, the Project will add a limited increment to the level of cumulative impact, but would not tip the balance of any specific cumulative impact from a less than significant level to a significant level."

#### **TMT Project Mitigation Measures**

The various mitigation measures and management actions that the TMT Project will implement are briefly described in <a href="Exhibit A-71">Exhibit A-71</a>. A more comprehensive recitation of these mitigation measures and actions can be found in the TMT Final EIS, CDUA, and TMT Management Plan appended to the CDUA as Exhibit B. <a href="Exhibits A-1">Exhibits A-1</a>, A-2, A-3, A-4, A-5. These mitigation measures and management actions have been considered throughout the Project planning process and incorporated into the Project design and construction plans.

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James T) Hayes President, Planning Solutions, Inc.